Title: The Way to Better Grades!

Brief Overview:

Students will use anonymous data concerning student quarter grades, homework, and attendance. Initially, a scatter plot and line of best fit will be created by hand. The data set will then be transferred to a graphing calculator to determine the scatter plot and line of best fit. The results of the two methods will be compared. Using the calculator to make a scatter plot, line of best fit, and the median fit method students will analyze the second set of data. Students will make conclusions as to which factor had a greater effect on the quarter grades. Their written conclusions will include comparing the plotting techniques and best fit methods. Additionally, students will use the best-fit line to make predictions.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will apply the process of mathematical modeling to real-world problem situations.

- **Mathematics as Reasoning**
  Students will make and test conjectures.

- **Mathematics as Communication**
  Students will reflect upon and clarify their thinking about mathematical ideas and relationships. Students will express mathematical ideas in writing.

- **Statistics**
  Students will construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations. Students will use curve fitting to predict from data.

Grade/Level:

Grades 9-12, Algebra I

Duration/Length:

This activity will take 2 block periods or 3-4 days. The activities may take longer than anticipated depending on student's prior knowledge.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Graphing points and linear equations
- Finding the equation of a line using slope and y-intercept
- Familiarity with graphing calculator
- Knowledge of basic statistics terms

Objectives:

Students will be able to:

- graph a set of data points on a coordinate grid.
- determine and write an equation for a line that students fit to data.
- find, given a set of data points, the equation for a line of best fit, using linear regression and the median fit method on the TI-83, and then use the equations to make predictions.
- make a written analysis of the data sets.

Materials/Resources/Printed Materials:

- Pencils
- Graph paper
- Graphing calculators and overhead (TI-83 is the model used for instructions)
- Student worksheets
- Teacher resource worksheet
- Rulers
- Data sets (either your class grades, a class from last year, or the sample class information provided)

Development/Procedures:

- Review/instruct students in creating a scatter plot by hand and on the TI-83.
- Provide students with class grades, homework, and attendance for one quarter.
- Encourage students to work collaboratively on the activity sheet. Teacher should circulate throughout the room to assist students particularly with calculator directions.
- Assessment tool is a written analysis of data sets.

Evaluation:

Written analysis of effects upon grades inferred from the scatter plots and best fit lines. Writing will include predictions based upon the graphs developed.

Extension/Follow Up:

- One week prior to learning unit, have the students log the time they spend daily watching television. Students collect class data sets on television viewing and use it as an additional factor to plot and analyze the effects upon grades, if any.
- Brainstorm additional factors that students feel positively or negatively affect quarter grades. Collect data for at least one of those factors in order to plot and test their conjectures.
- Regraph the attendance versus grades plot without the outliers. Compare this graph with the original, and discuss the effects of outliers on scatter plots.
- Plot and analyze the relationship between attendance and homework.

Authors:

Tommie Champ
Marshall High School
Fairfax County, VA

Ann Seabrooke
Marshall High School
Fairfax County, VA

NAME: _____ DATE: _____

Student Activity Sheet

A. Predictions:

1. Make a prediction about how the amount of homework you turn in affects your grades positively, negatively, or not at all. Explain your prediction.

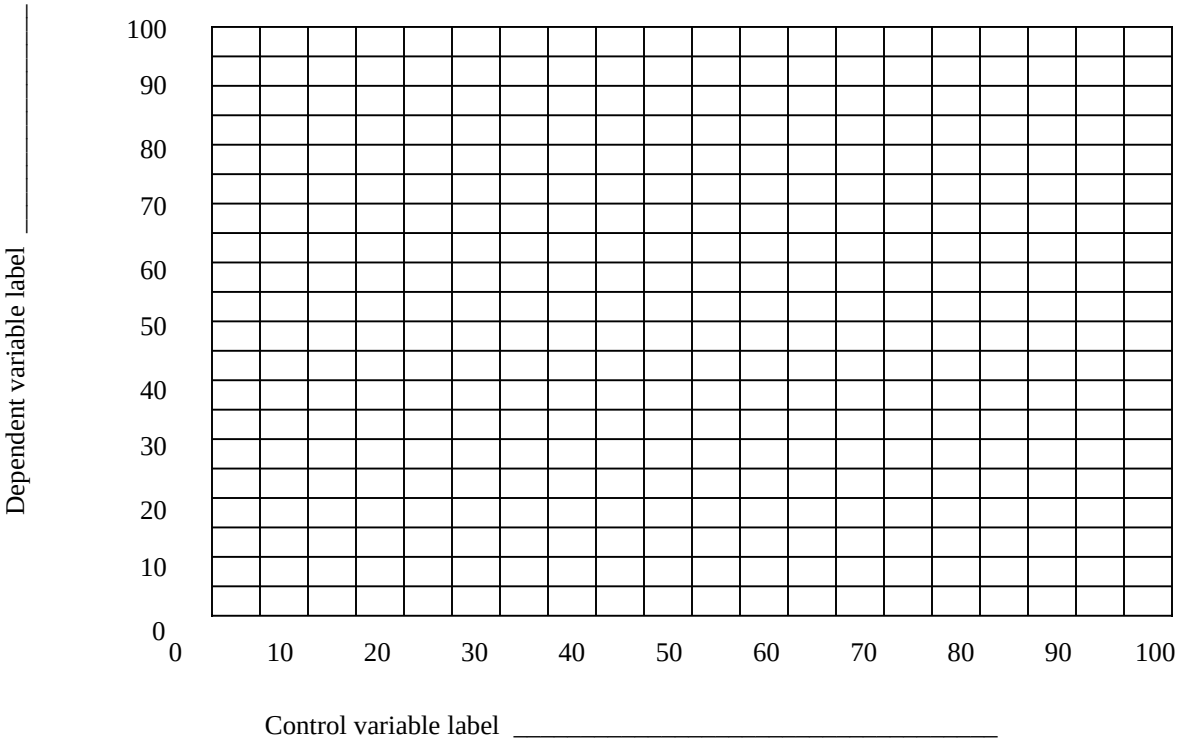
2. Make a prediction about whether attending class affects your grades positively, negatively, or not at all. Explain your prediction.

B. Scatter Plots:

1. Use the grid below to plot the data points for *Homework Completion %* and *Quarter Grade %*. Which is the controlling factor?

   Put the controlling factor on the X-axis, and the dependent factor on the Y-axis. Be sure to label your axes and graph. Does your scatter plot show a positive, negative, or no correlation?

GRAPH LABEL _____



2. Did the scatter plot support your initial prediction?

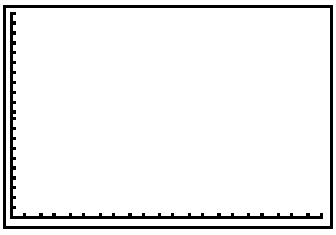
3. Using your ruler, draw in a line of best fit that you feel best fits this data set. Find the slope of your line and write an equation for your line of best fit. (HINT: Try picking two points on the line to calculate slope)

   Slope =

   Y =

4. Enter the same data sets into the calculator under STAT **EDIT** for lists $\mathbf{L}_1$ (quarter grades) and $\mathbf{L}_2$ **(**homework**)**.

5. Push Y= key and clear out any equations there.
6. Then hit 2ND, Y= to get to the statistics plots.
7. Push ENTER to get into **Plot1.** Turn on the plot by pushing ENTER to highlight **ON**.
8. Arrow down and highlight the first picture next to **Type:** which is the scatter plot.
9. Arrow down and use $\mathbf{L}_2$ for **Xlist** (control variable – press 2ND 2) and $\mathbf{L}_1$ for **Ylist** (dependent variable – press 2ND 1).
10. Push WINDOW and enter in the same scales that you used on your graph paper. Now press GRAPH to see the scatter plot.
11. Sketch the scatter plot that you see on the grid to the right.



C. Line of Best Fit:

1. Press STAT. Move the cursor to **CALC**.
2. Select the **LinReg(ax+b)** option. Type $\mathbf{L}_2$, $\mathbf{L}_1$, $\mathbf{Y}_1$ (For $\mathbf{Y}_1$ press VARS. Move the cursor to **Y-VARS**. Select **Function** then $\mathbf{Y}_1$**)**. This will tell the calculator to use $\mathbf{L}_2$ for the control variable and $\mathbf{L}_1$ for the dependent variable and then put the equation onto your Y= screen. Now press ENTER. The calculator has just calculated the line of best fit. Write down that equation: Y = _____

What does the variable ***a*** represent from your line of best fit?
What does the variable ***b*** represent?

The value for ***r*** if shown is the correlation coefficient. This number tells you how well your line fits the data set. The closer the number is to 1 or –1, the better the fit. Now press GRAPH to see the scatter plot and the calculated line of best fit. Go back to *Homework vs. Grades* grid and sketch in this line.

3. Press Y= and enter into $\mathbf{Y}_2$ the line of best fit that you calculated by hand. Press GRAPH and compare the two lines. How close was your estimate?

Why do you think there is a discrepancy, if any?

D. **Predictions:**
Student #8 received a C this quarter, and would like to achieve a B (84-89%) next quarter. Predict how much homework this student would need to complete to achieve his/her goal.

E. The Attendance Factor:

1. Enter in the data for attendance into $\mathbf{L}_3$. Remember to press STAT **EDIT** to return to lists. Press Y= and clear out all equations.
Press 2ND Y= to return to the statistics plot. Press ENTER to go into the 1st plot. The only thing you need to change here are your X and Y lists. Which factor do you believe controls the other factor?

2. Enter $\mathbf{L}_3$ in **Xlist**, and $\mathbf{L}_1$ in **Ylist**. Push GRAPH to see your scatter plot. Does your scatter plot have a positive, negative, or no correlation?

Does the graph support your initial prediction?

Are there any obvious outliers in the data set?

3. Follow the above steps to calculate the line of best fit for this new data set $[\mathbf{L}_3, \mathbf{L}_1, \mathbf{Y}_1]$. Write down your line of best fit.

Y =_____

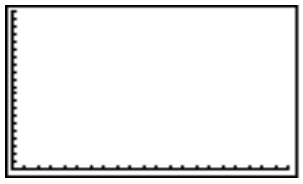
Look at the correlation coefficient to see how well the line fits your data set. Remember the closer to 1 or –1, the better the fit. How do you think the outliers, if any, affect the line of best fit?

F. Median Fit Method:

1. Calculate the line of best fit using the median fit method. Press STAT. Move the cursor to **CALC**. Select the **Med-Med** option. Enter $\mathbf{L}_3$ followed by [,]. Enter $\mathbf{L}_1$ followed by [,]. Press VARS. Move the cursor to **Y-VARS**. Select **Function**, then select $\mathbf{Y_2}$. Write down your equation: Y = _____Push ENTER. Push GRAPH.

2. Sketch the scatter plot, line of best fit, and median fit line on the grid to the right.

Attendance vs. Grades



3. Which line do you think fits the data set best? Why?

4. Your family is planning a vacation and you will miss an entire week of school (3 block periods). There are 9 weeks in the quarter, or 22 block periods. What impact do you think going on your family vacation will have upon your grade for next quarter?

G. Written Analysis:

1. Which factor affected grades the most, homework completion or attendance?

2. For analyzing data which representation do you prefer, table, scatter plot, or equation of a line? Explain your reasoning.

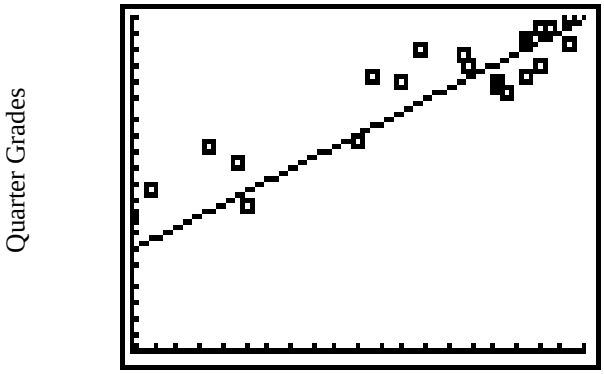
3. What other factors do you feel might affect quarter grades? Why?

Sample Algebra I Class Data (From My Own Class):

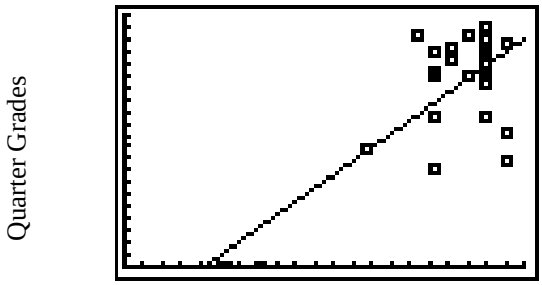
Student ID#	Homework Completion %	Attendance - % Present	Quarter Grades - %
1	25	100	44
2	74	86	86
3	93	77	96
4	81	95	79
5	0	27	0
6	53	82	82
7	0	36	0
8	83	95	77
9	97	95	92
10	97	95	100
11	64	82	90
12	87	95	82
13	17	82	62
14	73	95	89
15	90	95	85
16	4	64	49
17	87	100	93
18	0	82	40
19	81	82	80
20	60	91	80
21	87	86	92
22	90	91	97
23	104	95	94
24	23	100	56
25	50	95	63

TEACHER RESOURCE SHEET

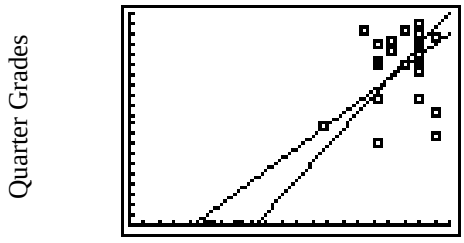
Scatter Plot for Homework and Quarter Grades including the line of best fit:



Scatter Plot for Attendance and Quarter Grades including the line of best fit:



Scatter Plot for Attendance and Quarter Grades including the line of best fit and the median fit line:



NAME: **Key** DATE: _____

Student Activity Sheet

A. Predictions:

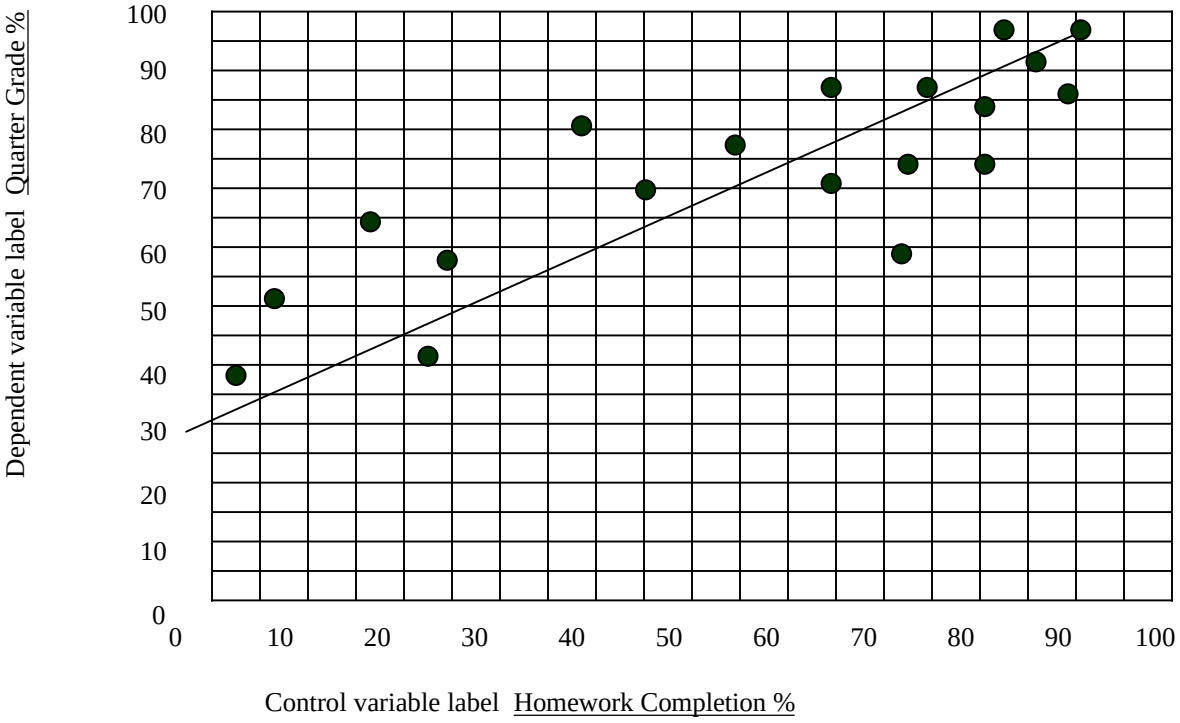
1. Make a prediction about how the amount of homework you turn in affects your grades positively, negatively, or not at all. Explain your prediction. Positively affects grades because you learn more from doing homework. (2 Points)

2. Make a prediction about whether attending class affects your grades positively, negatively, or not at all. Explain your prediction. Positively affects grades because you need to be in class to learn the material. (2 Points)

B. Scatter Plots:

1. Use the grid below to plot the data points for *Homework Completion %* and *Quarter Grade %*. Which is the controlling factor? Homework completion % controls Quarter Grade %. (6 points)
   Put the controlling factor on the X-axis, and the dependent factor on the Y-axis. Be sure to label your axes and graph. Does your scatter plot show a positive, negative, or no correlation? Positive correlation.

GRAPH LABEL Effect of Homework Completion on Quarter Grades



2. Did the scatter plot support your initial prediction? Yes (1 Point)

3. Using your ruler, draw in a line of best fit that you feel best fits this data set. Find the slope of your line and write an equation for your line of best fit. (HINT: Try picking two points on the line to calculate slope.) (0, 30) (55, 70) (4 Points)

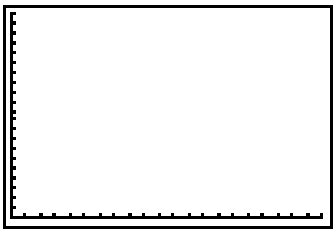
Slope = $\frac{70-30}{55-0} = \frac{40}{55} = \frac{8}{11}$

Y = 8/11 X + 30

4. Enter the same data sets into the calculator under STAT **EDIT** for lists $\mathbf{L}_1$ (quarter grades) and $\mathbf{L}_2$ **(**homework**)**.

5. Push Y= key and clear out any equations there.
6. Then hit 2ND, Y= to get to the statistics plots.
7. Push ENTER to get into **Plot1.** Turn on the plot by pushing ENTER to highlight **ON**.
8. Arrow down and highlight the first picture next to **Type:** which is the scatter plot.
9. Arrow down and use $\mathbf{L}_2$ for **Xlist** (control variable – press 2ND 2) and $\mathbf{L}_1$ for **Ylist** (dependent variable – press 2ND 1).
10. Push WINDOW and enter in the same scales that you used on your graph paper. Now press GRAPH to see the scatter plot.
11. Sketch the scatter plot that you see on the grid to the right. See Teacher Resource Sheet for Answer. (4 Points)

Homework vs. Grades



C. Line of Best Fit:

1. Press STAT. Move the cursor to **CALC**.
2. Select the **LinReg(ax+b)** option. Type $\mathbf{L}_2$, $\mathbf{L}_1$, $\mathbf{Y}_1$ (For $\mathbf{Y}_1$ press VARS. Move the cursor to **Y-VARS**. Select **Function** then $\mathbf{Y}_1$**)**. This will tell the calculator to use $\mathbf{L}_2$ for the control variable and $\mathbf{L}_1$ for the dependent variable and then put the equation onto your Y= screen.

Now press ENTER. The calculator has just calculated the line of best fit.
Write down that equation: Y = .6932721102X + 30.1690557
What does the variable ***a*** represent from your line of best fit?
Slope of Line (4 Points)
What does the variable ***b*** represent?
y- intercept
The value for ***r*** if shown is the correlation coefficient. This number tells you how well your line fits the data set. The closer the number is to 1 or –1, the better the fit. Now press GRAPH to see the scatter plot and the calculated line of best fit. Go back to *Homework vs. Grades* grid and sketch in this line. r = .89 See Teacher Resource Sheet

3. Press Y= and enter into $\mathbf{Y}_2$ the line of best fit that you calculated by hand. Press GRAPH and compare the two lines. How close was your estimate? Very close, amount almost exact until it got up to the upper right hand corner . (2 Points)
Why do you think there is a discrepancy, if any? Because we estimated by our eyes, the line of best fit instead of calculating from the data.

D. **Predictions:**
Student #8 received a C this quarter, and would like to achieve a B (84-89%) next quarter. Predict how much homework this student would need to complete to achieve his/her goal. About 78% - 85% of homework. Use trace on calculator. (2 Points)

E. The Attendance Factor:
1. Enter in the data for attendance into $\mathbf{L}_3$. Remember to press STAT **EDIT** to return to lists. Press Y= and clear out all equations.
Press 2ND Y= to return to the statistics plot. Press ENTER to go into the 1st plot. The only thing you need to change here are your X and Y lists. Which factor do you believe controls the other factor?
Attendance controls quarter grades. (2 Points)

2. Enter $\mathbf{L}_3$ in **Xlist**, and $\mathbf{L}_1$ in **Ylist**. Push GRAPH to see your scatter plot. Does your scatter plot have a positive, negative, or no correlation? No correlation or weak positive correlation

Does the graph support your initial prediction? No (3 Points)

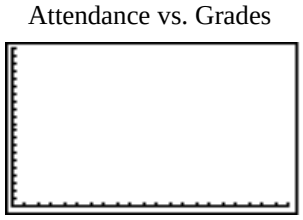
Are there any obvious outliers in the data set? Yes, (27,0) and (36,0)

3. Follow the above steps to calculate the line of best fit for this new data set [$\mathbf{L}_3$, $\mathbf{L}_1$, $\mathbf{Y}_1$]. Write down your line of best fit.
   Y = 1.133955479X – 23.97549926
   Look at the correlation coefficient to see how well the line fits your data set. Remember the closer to 1 or –1, the better the fit. How do you think the outliers, if any, affect the line of best fit? r = .7495, They pull the y-intercept down and make the slope steeper. (4 Points)

F. Median Fit Method:

1. Calculate the line of best fit using the median fit method. Press STAT. Move the cursor to **CALC**. Select the **Med-Med** option. Enter $\mathbf{L}_3$ followed by [,]. Enter $\mathbf{L}_1$ followed by [,]. Press VARS. Move the cursor to **Y-VARS**. Select **Function**, then select $\mathbf{Y_2}$. Write down your equation: Y = 1.653846154X – 68.19871795 (2 Points)
   Push ENTER. Push GRAPH.

2. Sketch the scatter plot, line of best fit, and median fit line on the grid to the right. See Teacher Resource Sheet for sketch. (3 Points)



3. Which line do you think fits the data set best? Why? Median -- Median fit splits the data so that there are the same number of points above and below the line whereas line of best fit does not. (2 Points)

4. Your family is planning a vacation and you will miss an entire week of school (3 block periods). There are 9 weeks in the quarter, or 22 block periods. What impact do you think going on your family vacation will have upon your grade for next quarter? Use trace on calculator.
   22 – 3 = 19 and 19/22 = .8637 (2 Points)

Line of Best Fit approaches 73.7% for quarter grade, while Median – median line approaches 74.3% for quarter grade. You will most likely get a low C for quarter grade.

G. Written Analysis:

1. Which factor affected grades the most, homework completion or attendance? Homework completion (1 Point)

2. For analyzing data which representation do you prefer, table, scatter plot, or equation of a line? Explain your reasoning. Scatter plot with a best fit because it is easier to see correlations and trace along the line to make predictions. (2 Points)

3. What other factors do you feel might affect quarter grades? Why? Amount of time spend watching television because then you have less time to do homework, and we have just proven a positive correlation between doing homework and getting good grades. (2 Points)

NOTE: Since questions are open-ended, answers will most likely vary. Example answers are provided in key.

Sample Algebra I Class Data (From My Own Class):

Student ID#	Homework Completion %	Attendance - % Present	Quarter Grades - %
1	25	100	44
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8	83	95	77
9	97	95	92
10	97	95	100
11	64	82	90
12	87	95	82
13	17	82	62
14	73	95	89
15	90	95	85
16	4	64	49
17	87	100	93
18	0	82	40
19	81	82	80
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22	90	91	97
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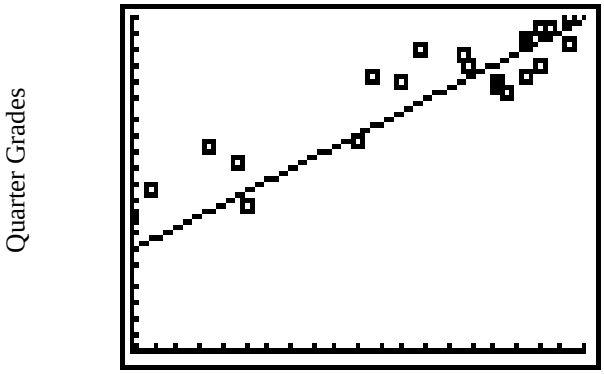
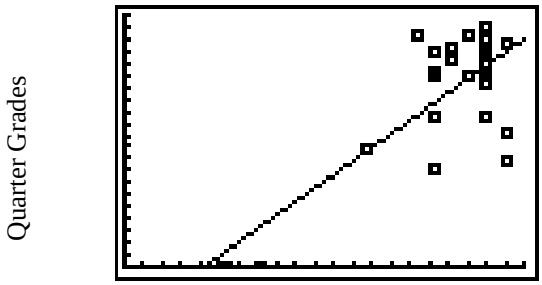
24	23	100	56
25	50	95	63

TEACHER RESOURCE SHEET

Scatter Plot for Homework and Quarter Grades including the line of best fit:



Scatter Plot for Attendance and Quarter Grades including the line of best fit:



Scatter Plot for Attendance and Quarter Grades including the line of best fit and the median fit line: